US009316991B2

(12) **United States Patent**
Takagi

(10) **Patent No.: US 9,316,991 B2**
(45) **Date of Patent: Apr. 19, 2016**

(54) **DEVELOPER CARTRIDGE**

(71) Applicant: **Takeyuki Takagi**, Nagoya (JP)

(72) Inventor: **Takeyuki Takagi**, Nagoya (JP)

(73) Assignee: **Brother Kogyo Kabushiki Kaisha**, Nagoya-shi, Aichi-ken (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/928,465**

(22) Filed: **Jun. 27, 2013**

(65) **Prior Publication Data**

US 2013/0287425 A1 Oct. 31, 2013

Related U.S. Application Data

(63) Continuation-in-part of application No. PCT/JP2011/080014, filed on Dec. 26, 2011.

(30) **Foreign Application Priority Data**

Dec. 27, 2010 (JP) 2010-290486

(51) **Int. Cl.**
G03G 21/18 (2006.01)
G03G 15/00 (2006.01)
G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/80*** (2013.01); ***G03G 15/0806*** (2013.01); ***G03G 15/0808*** (2013.01); ***G03G 15/0832*** (2013.01); ***G03G 15/0865*** (2013.01); ***G03G 15/0896*** (2013.01); *G03G 21/1867* (2013.01); *G03G 21/1871* (2013.01); *G03G 2221/163* (2013.01); *G03G 2221/166* (2013.01); *G03G 2221/1651* (2013.01);

(Continued)

(58) **Field of Classification Search**
CPC G03G 21/18
USPC 399/90
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,614,996 A * 3/1997 Tanda 399/120
7,236,726 B2 * 6/2007 Mori et al. 399/252

(Continued)

FOREIGN PATENT DOCUMENTS

JP 2000-010389 * 1/2000 ..... G03G 15/08
JP 2000-010389 A 1/2000

(Continued)

OTHER PUBLICATIONS

International Preliminary Report on Patentability issued in corresponding International Application No. PCT/JP2011/080014 mailed Jul. 11, 2013.

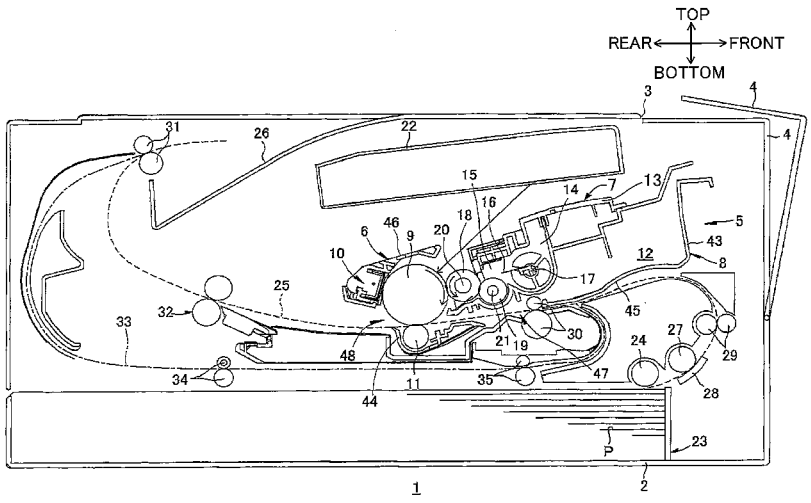
(Continued)

Primary Examiner — Clayton E Laballe
Assistant Examiner — Kevin Butler
(74) *Attorney, Agent, or Firm* — Banner & Witcoff, Ltd.

(57) **ABSTRACT**

A developer cartridge includes a case, a developer carrying member, a developer supplying member, a cap, an electrode, and a fixing member. The case has a first side wall formed with a toner fill-hole and a second side wall facing the first side wall in a particular direction. The cap is configured to seal the toner fill-hole. The electrode is configured to supply a bias voltage to at least one of the developer carrying member and the developer supplying member. The fixing member is configured to fix the electrode to the cap such that the electrode is disposed in superposed relation to the cap in the particular direction.

9 Claims, 15 Drawing Sheets



(52) **U.S. Cl.**
CPC . *G03G 2221/1657* (2013.01); *G03G 2221/183* (2013.01); *G03G 2221/1815* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,561,817	B2	7/2009	Sato	
RE42,885	E	11/2011	Yamaguchi et al.	
2005/0190997	A1	9/2005	Yamguchi et al.	
2006/0171737	A1	8/2006	Nishimura et al.	
2006/0171743	A1*	8/2006	Mori et al.	399/252
2006/0193652	A1	8/2006	Sato	
2007/0009281	A1	1/2007	Sato et al.	
2007/0009282	A1	1/2007	Sato et al.	
2008/0298838	A1*	12/2008	Sato et al.	399/119
2010/0296833	A1	11/2010	Sato et al.	
2011/0299875	A1	12/2011	Sato et al.	
2012/0251187	A1	10/2012	Sato et al.	
2013/0287425	A1*	10/2013	Takagi	399/90

FOREIGN PATENT DOCUMENTS

JP	2005-282677	A	10/2005	
JP	2006-235472	*	9/2006	G03G 15/08
JP	2006-235472	A	9/2006	
JP	2006-276690	*	10/2006	G03G 15/08
JP	2006-276690	A	10/2006	
JP	2007-102152	*	4/2007	G03G 15/08
JP	2007-102152	A	4/2007	
JP	2008-191401	A	8/2008	

OTHER PUBLICATIONS

Office Action issued in corresponding Japanese Patent Application No. 2010-290486 mailed Nov. 13, 2012.

Office Action issued in corresponding Japanese Patent Application No. 2010-290486 mailed Feb. 5, 2013.

* cited by examiner

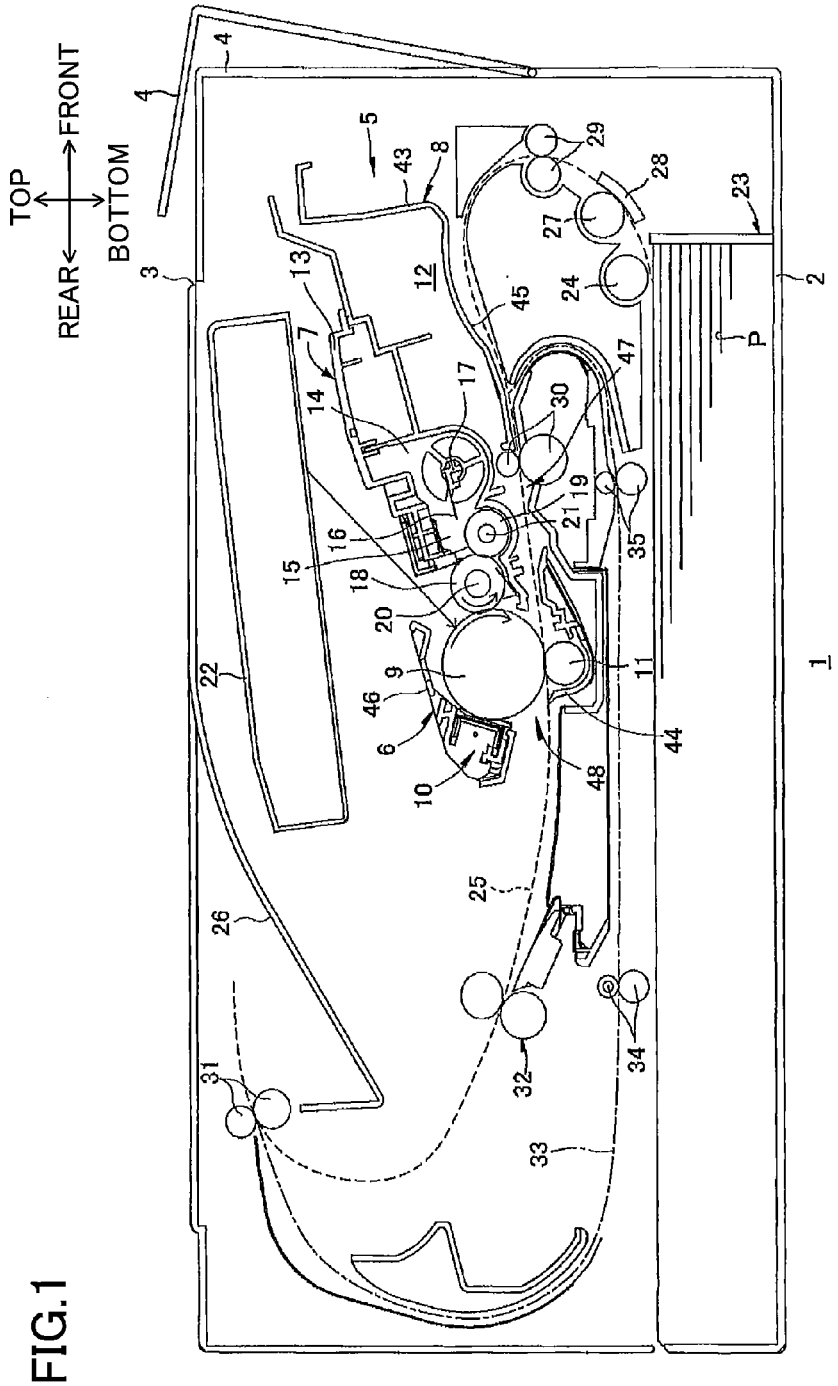

TOP
FRONT
REAR
BOTTOM
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
43
44
45
46
47
48
P

FIG.1

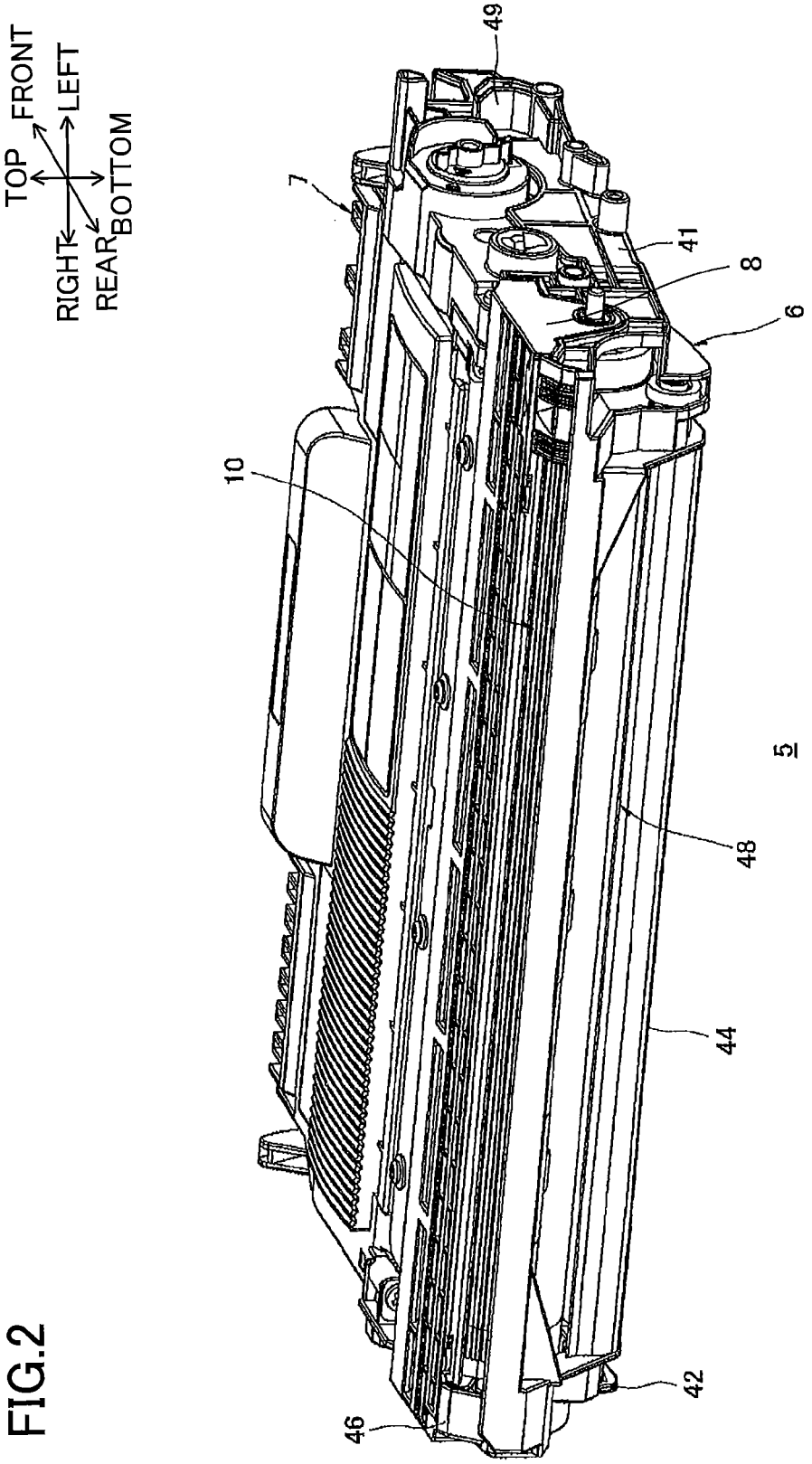


FIG.2

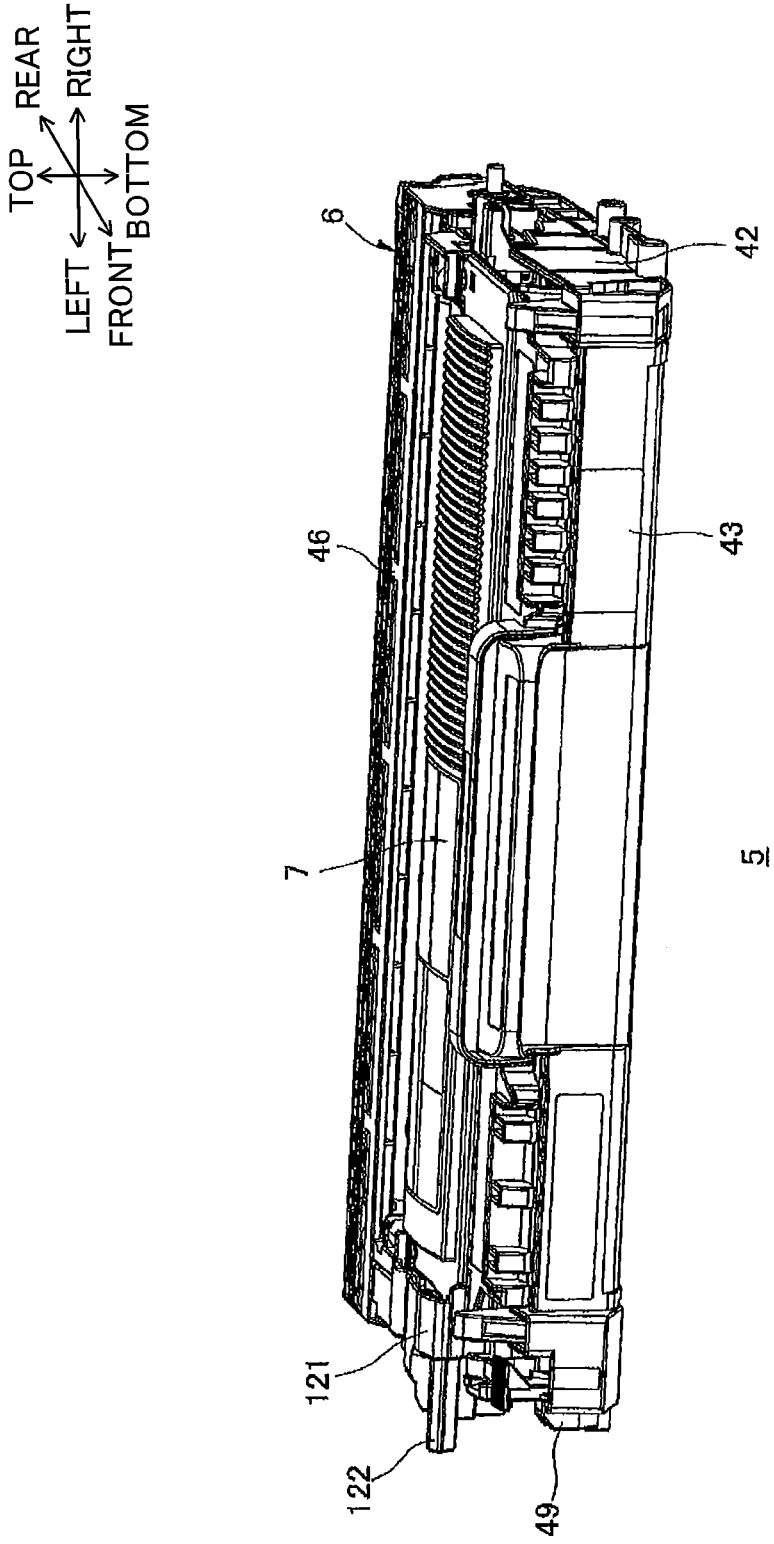


FIG.3

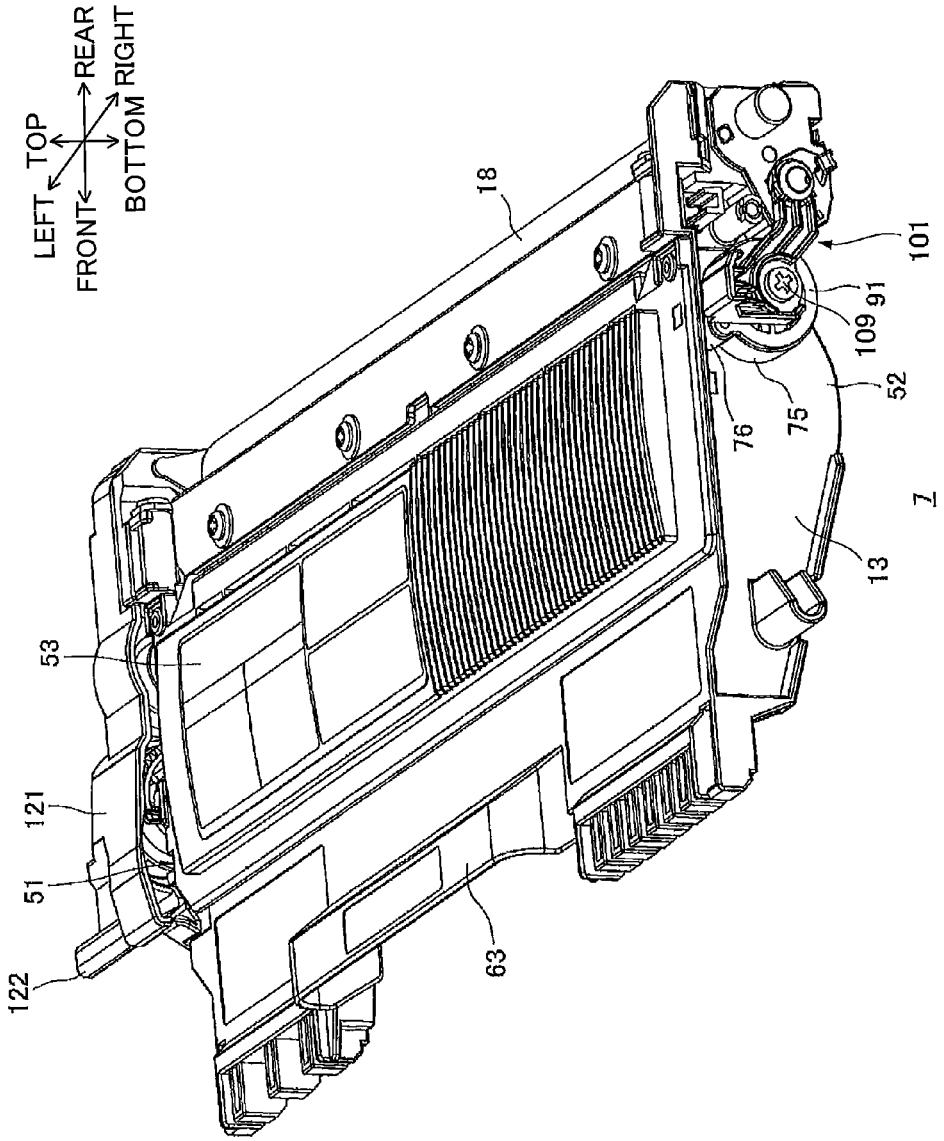

LEFT
TOP
REAR
FRONT
BOTTOM
RIGHT
18
101
91
109
52
76
75
7
13
53
121
51
122
63

FIG.4

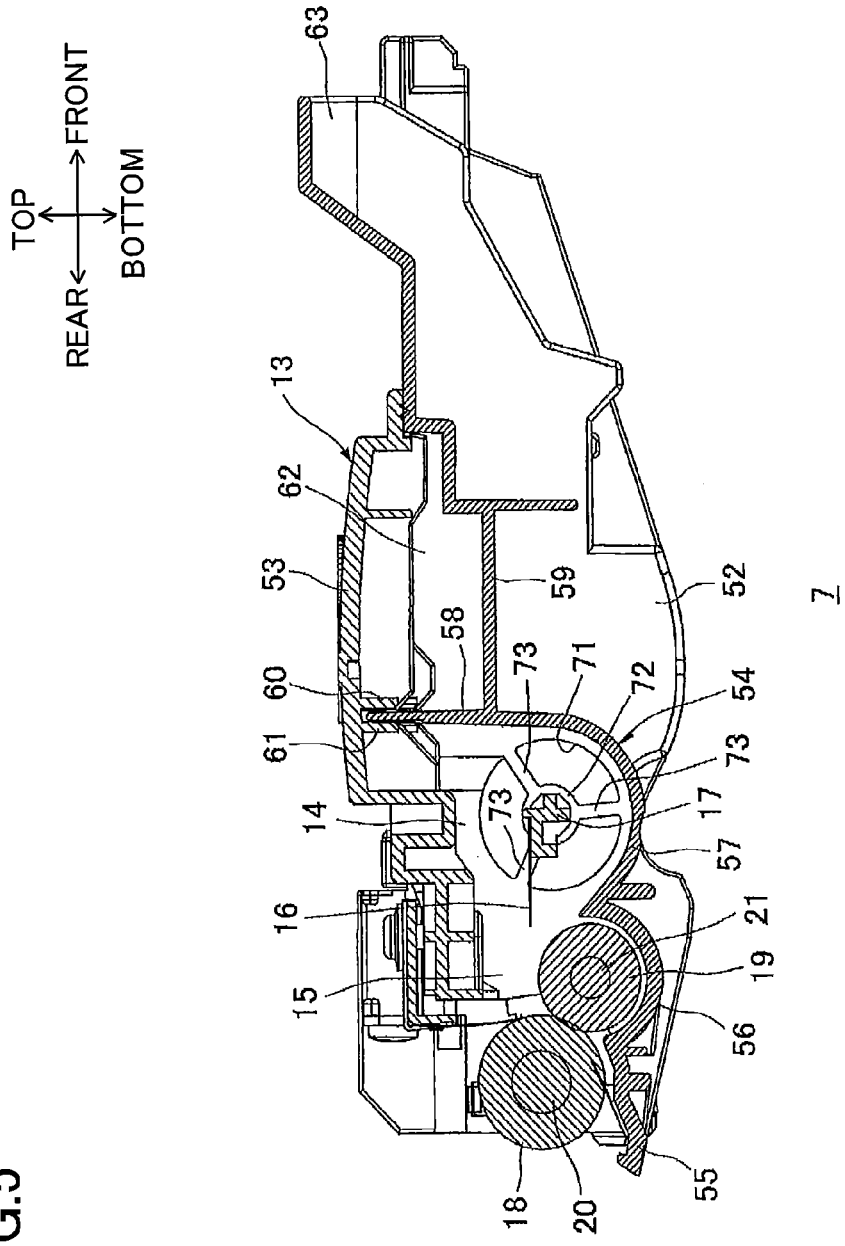

TOP
FRONT
REAR
BOTTOM
63
13
62
53
58
59
52
60
73
71
72
54
61
73
73
17
14
57
16
21
19
15
56
18
20
55
7

FIG.5

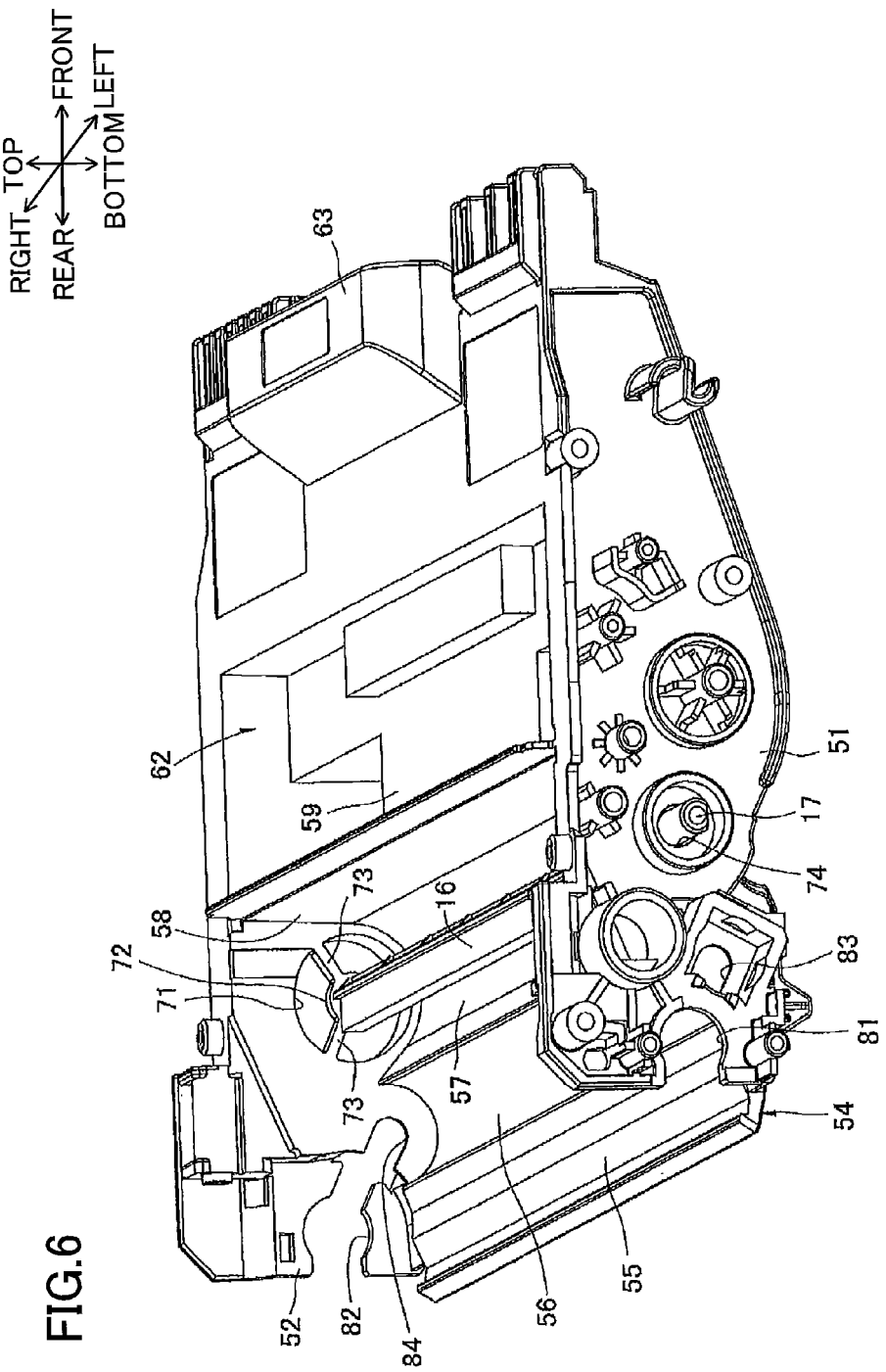

RIGHT
TOP
REAR
FRONT
BOTTOM
LEFT
63
62
59
73
16
58
72
71
73
57
52
82
84
56
55
54
81
83
74
17
51

FIG.6

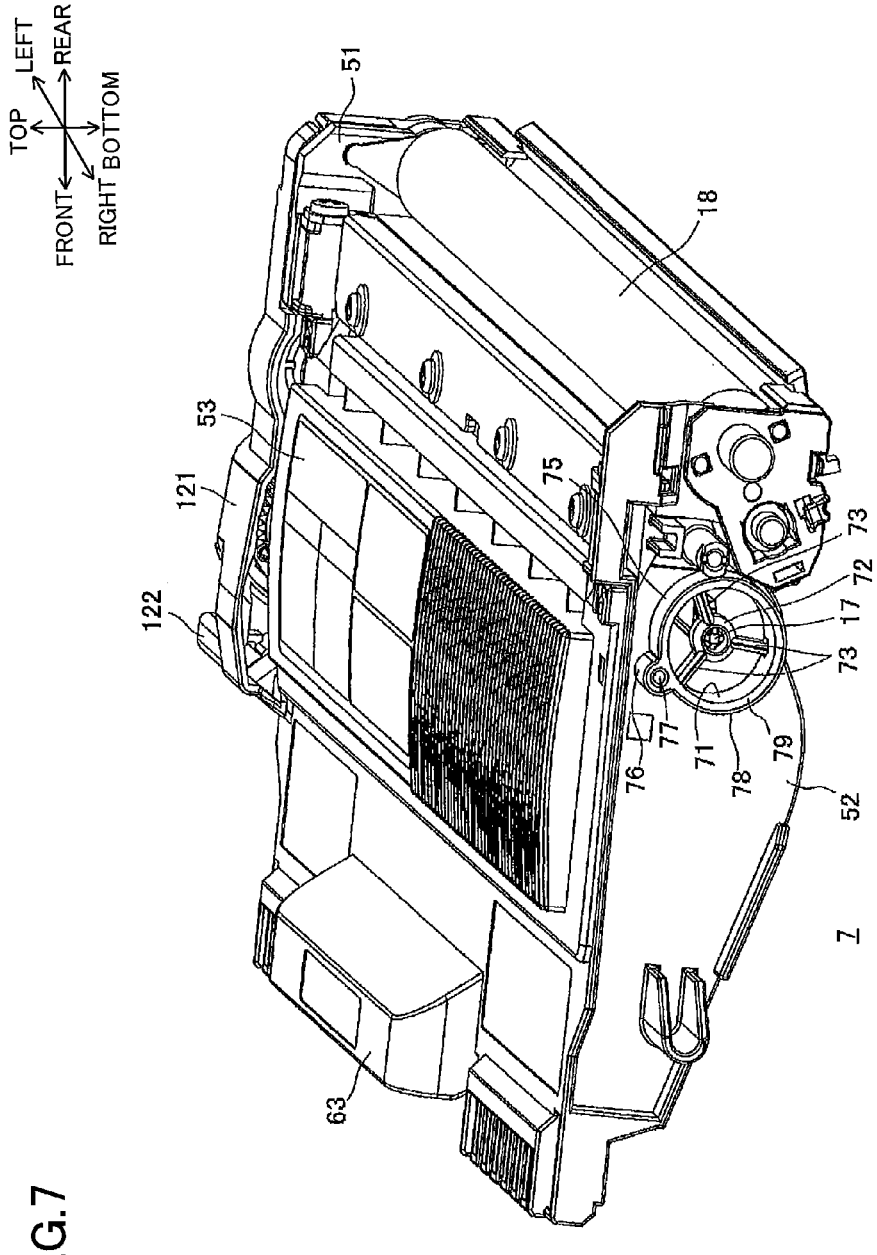
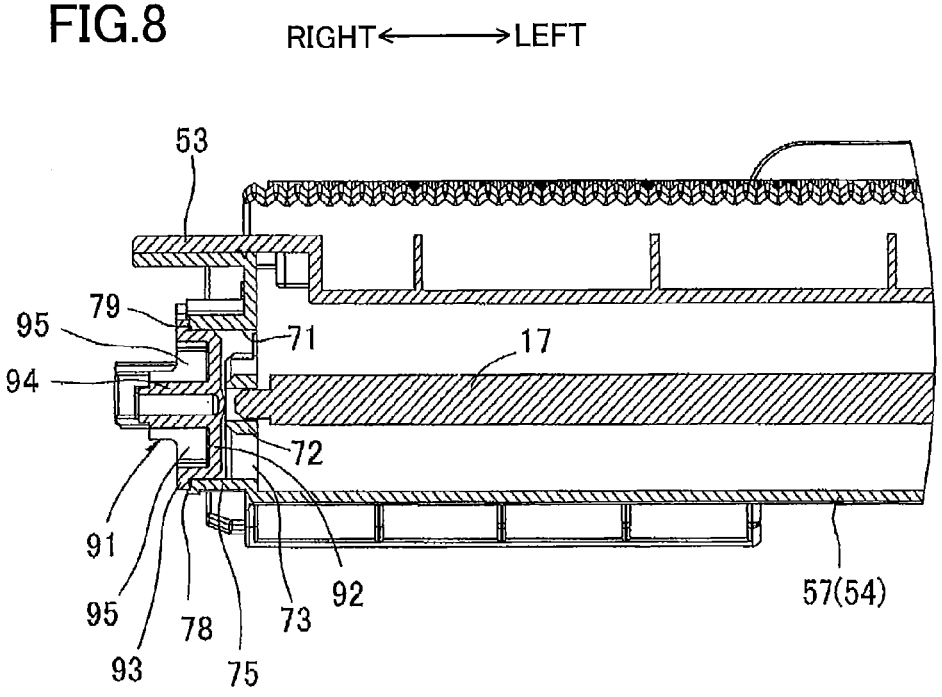

TOP
LEFT
REAR
FRONT
RIGHT
BOTTOM
51
18
53
121
122
75
73
72
17
73
77
71
79
76
78
52
63
Z

FIG.7

FIG.8



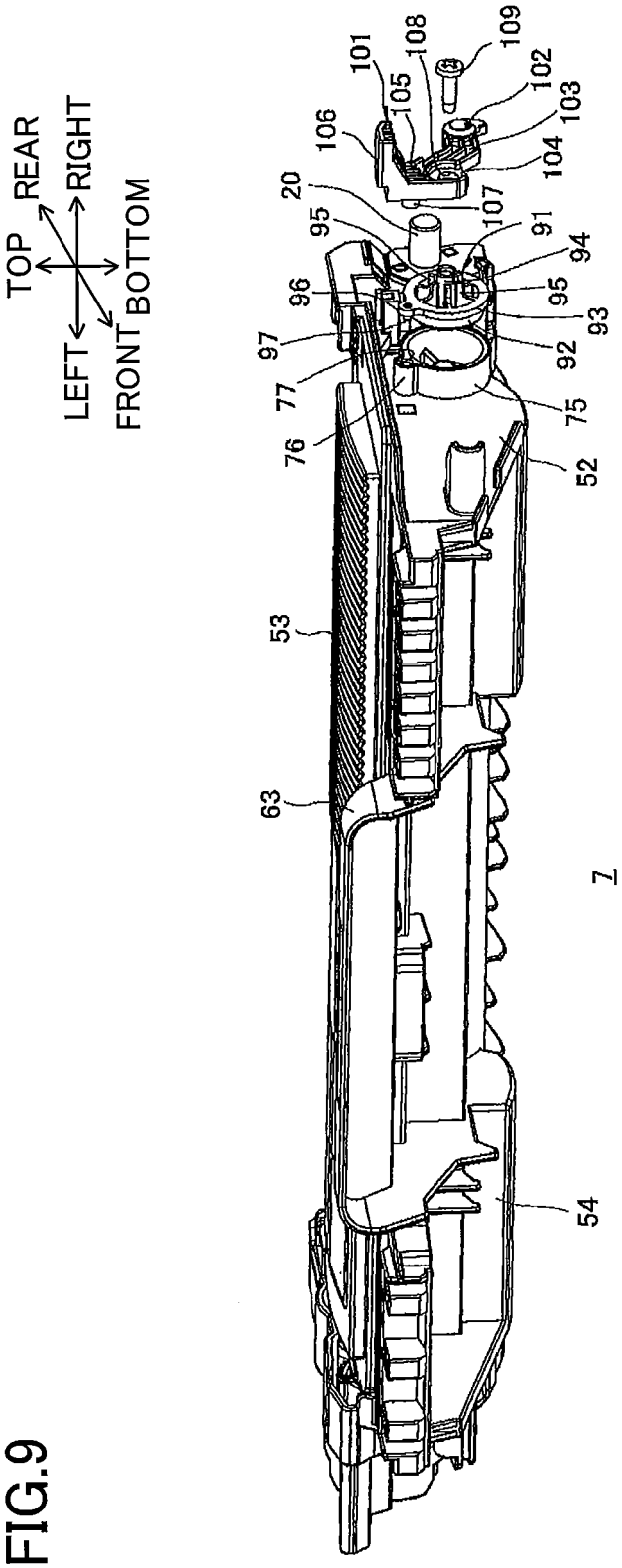

TOP
REAR
RIGHT
LEFT
FRONT
BOTTOM
101
108
109
102
105
103
106
104
20
107
95
91
94
96
95
93
97
92
77
75
76
52
53
63
7
54

FIG.9

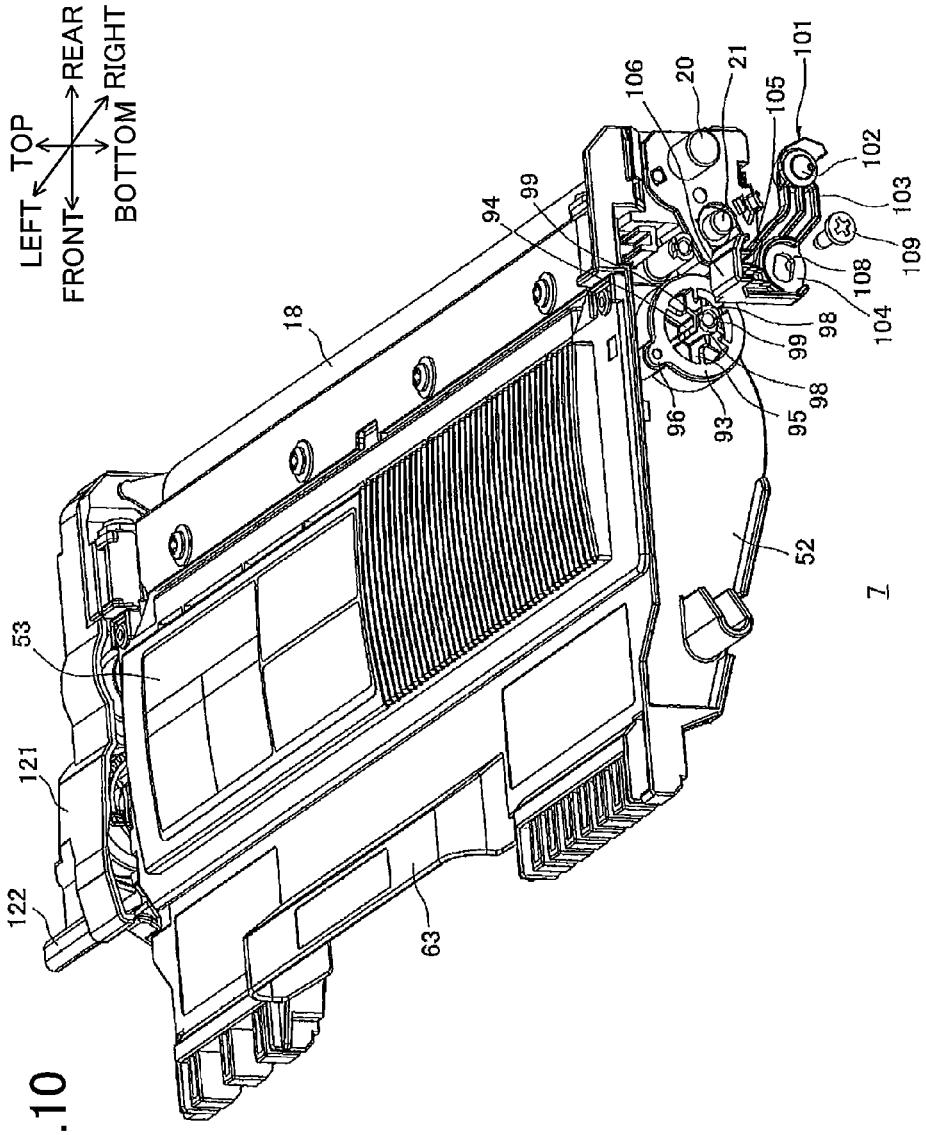

TOP
REAR
LEFT
RIGHT
FRONT
BOTTOM
7
18
20
21
52
53
63
93
94
95
96
98
99
101
102
103
104
105
106
108
109
121
122

FIG.10

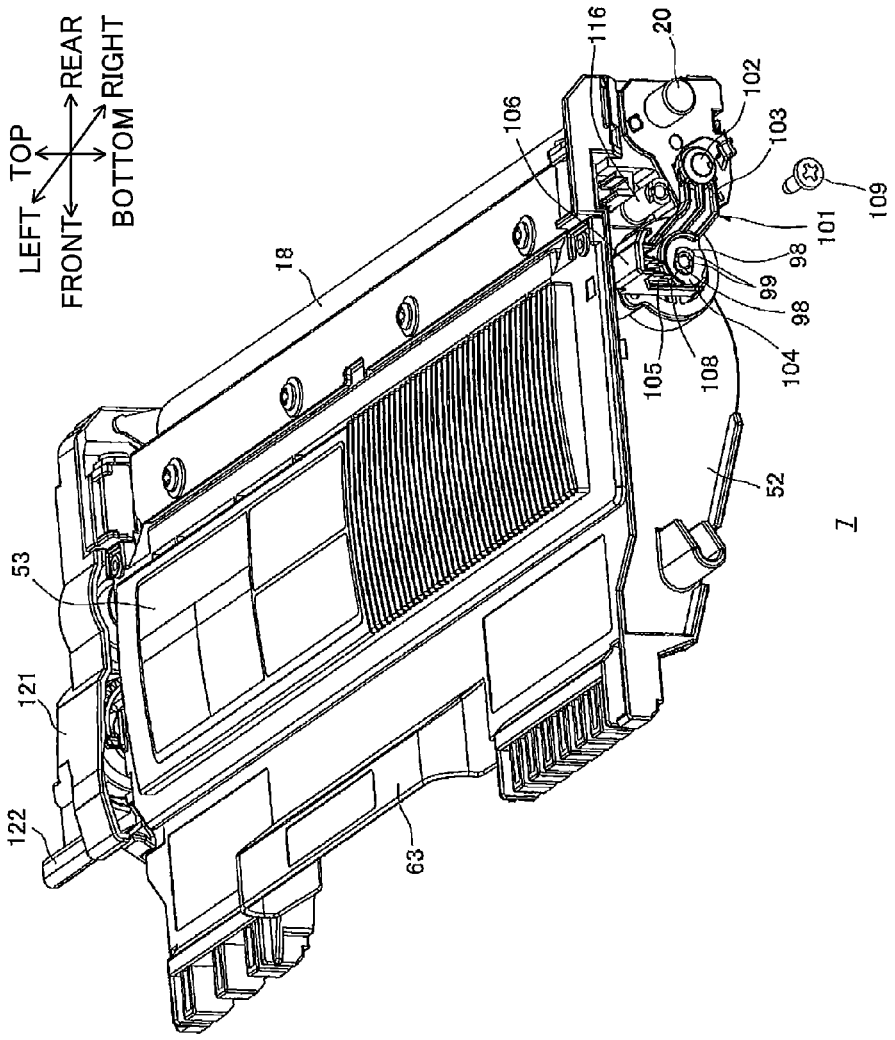

TOP
LEFT
FRONT
REAR
RIGHT
BOTTOM
116
20
102
103
106
109
101
98
99
98
18
105
108
104
52
Z
53
121
122
63

FIG.11

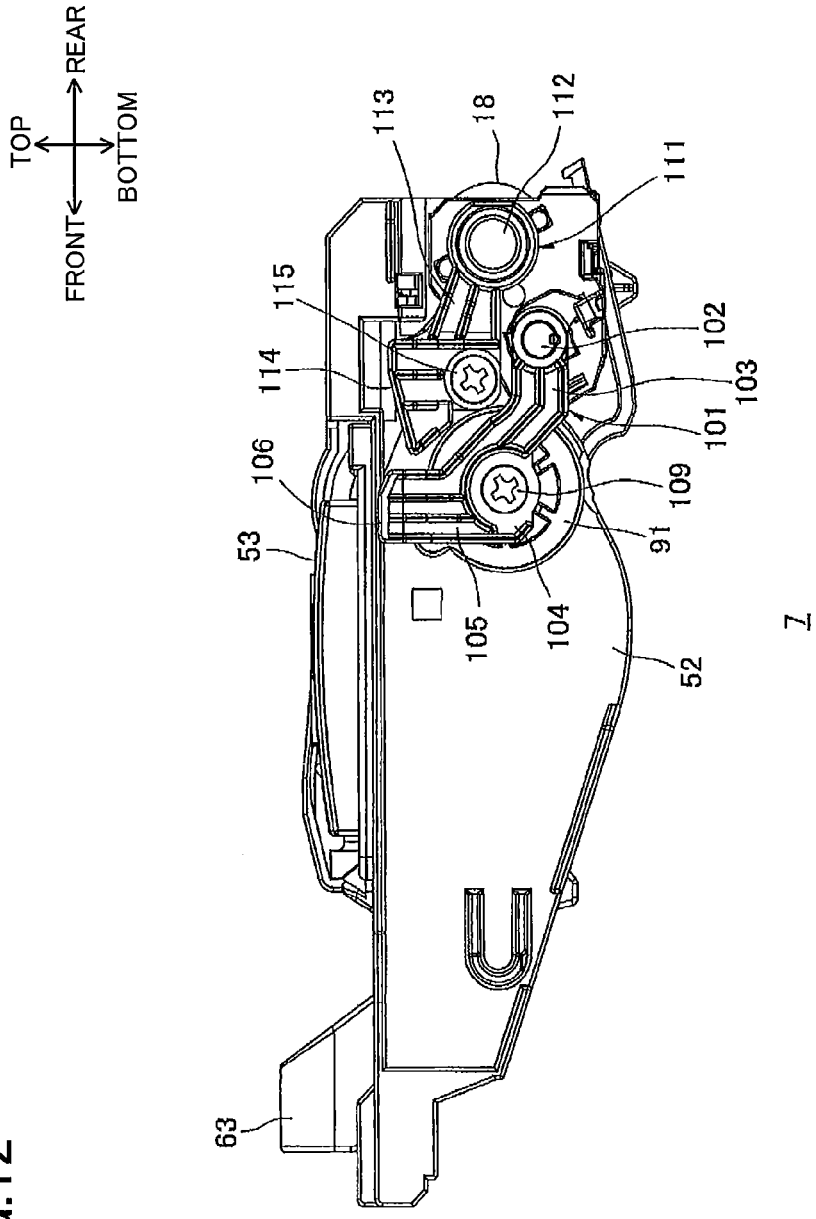

TOP
REAR
FRONT
BOTTOM
113
18
112
111
115
102
114
103
101
106
109
53
91
105
104
52
63
Z

FIG.12

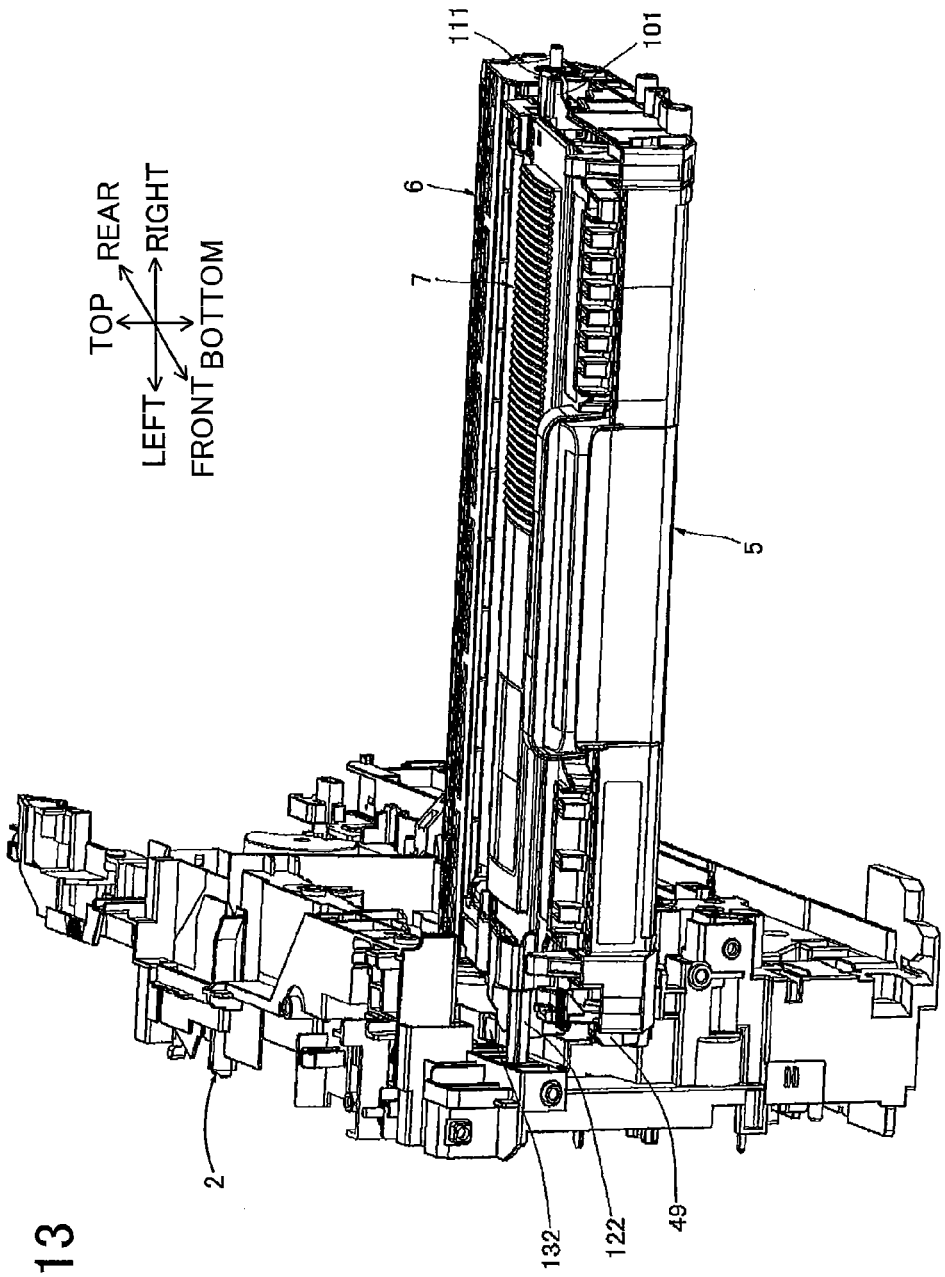


FIG.13

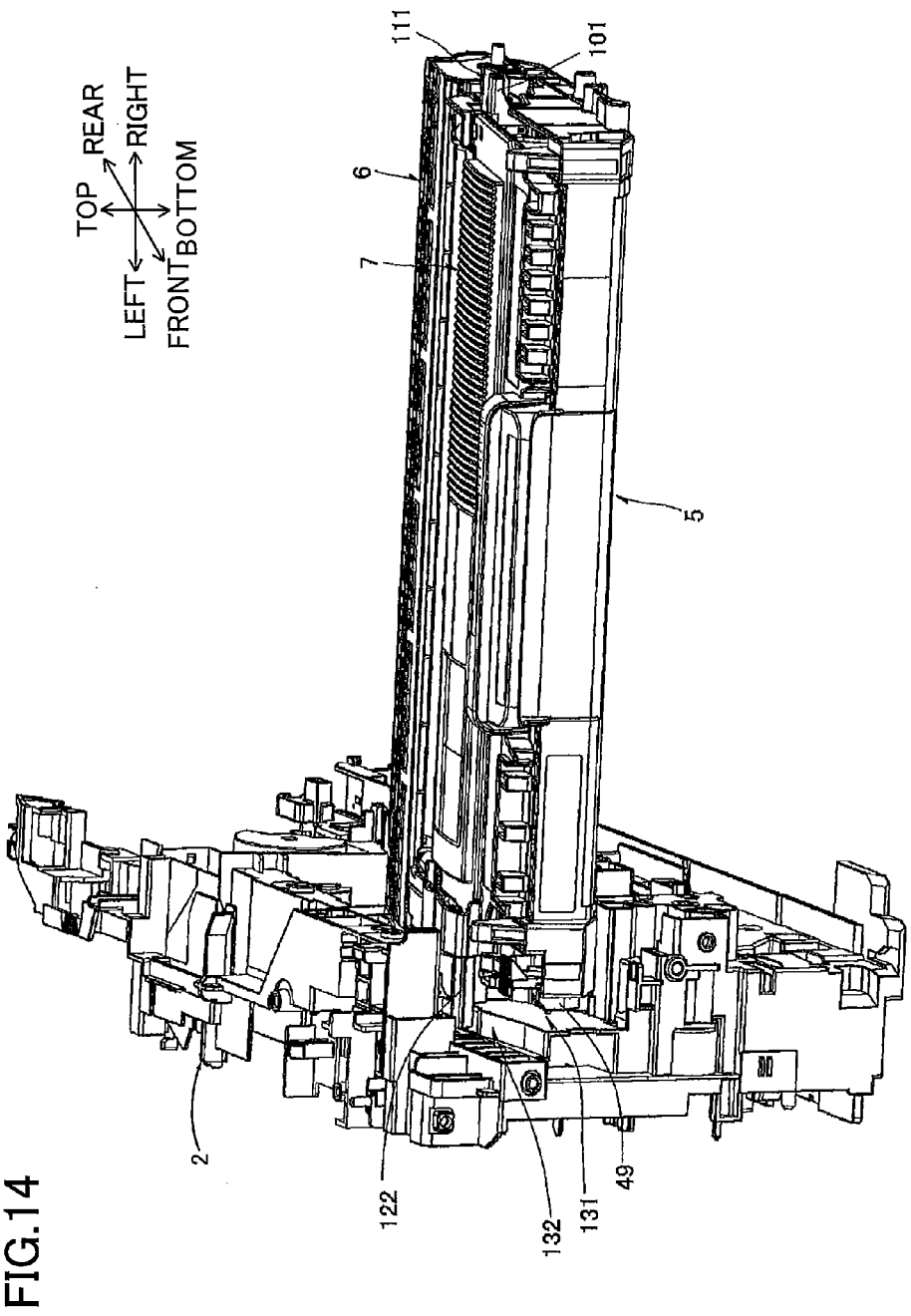


FIG.14

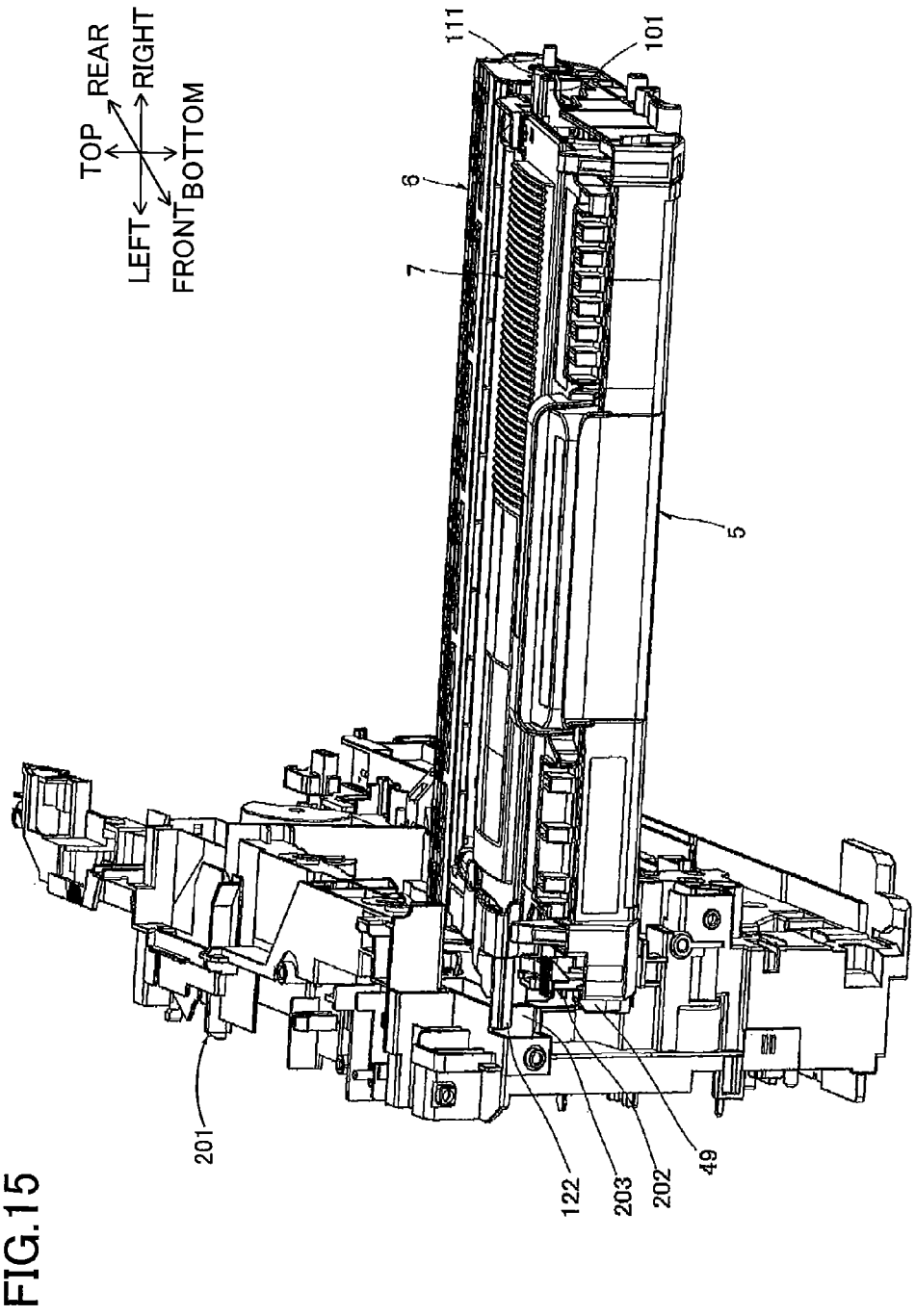

TOP
REAR
RIGHT
LEFT
FRONT
BOTTOM
111
101
6
7
5
201
122
203
202
49

FIG.15

DEVELOPER CARTRIDGE

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation in part of International Application No. PCT/JP2011/080014 filed Dec. 26, 2011 which claims priority from Japanese Patent Application No. 2010-290486 filed Dec. 27, 2010. The entire content of the international application and the priority application are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a developer cartridge provided in an image-forming device, such as a laser printer.

BACKGROUND

One conventional image-forming device has a photosensitive drum cartridge detachably mounted in the device body, and a developer cartridge that mounts on the photosensitive drum cartridge. The photosensitive drum cartridge is provided with a photosensitive drum, and the developer cartridge is provided with a developing roller and a supply roller.

A hopper is formed in the inside of the developer cartridge for accommodating toner. The supply roller in the developer cartridge supplies toner from the hopper onto the developing roller. As the photosensitive drum and the developing roller rotate, the developing roller supplies toner to an electrostatic latent image formed on the surface of the photosensitive drum, developing the latent image into a toner image. The toner image is transferred onto paper to complete the image-forming operation.

In order to implement this developing operation, the image-forming device must apply bias voltages to the developing roller and the supply roller. For this purpose, the developer cartridge is provided with a developing electrode and a supply electrode. The developing electrode and supply electrode are provided on a side surface of the developer cartridge and are electrically connected to the developing roller and supply roller, respectively. When the developer cartridge is mounted in the device body together with the photosensitive drum cartridge, the developing electrode and supply electrode are connected to electrodes provided in the device body, enabling the image-forming device to apply bias voltages to the developing electrode and supply electrode.

SUMMARY OF THE INVENTION

Developer cartridges have been made smaller and smaller in recent years, but this reduction in size brings with it limitations in how members can be provided on the side surface of the developer cartridge. For example, in addition to a developing electrode and supply electrode, a cap is also provided on one side surface of the developer cartridge for sealing a hole through which the hopper is filled with toner. Further, reducing the size of the developer cartridge results in a smaller hopper, requiring the cap to be positioned closer to the developing roller and supply roller. This gives rise to difficulties in arranging the developing electrode and supply electrode next to the cap.

Further, if the developing electrode or supply electrode is arranged to overlap the cap, the positioning of the electrode overlapping the cap becomes unstable, potentially leading to an unreliable connection between the electrode and the corresponding electrode in the device body.

In view of the foregoing, it is an object of the present invention to provide a developer cartridge having electrodes whose positions can be maintained with stability.

This and other object of the present invention will be attained by a developer cartridge including: a case, a developer carrying member, a developer supplying member, a cap, an electrode and a fixing member. The case includes a first side wall formed with a toner fill-hole and a second side wall facing in a particular direction to the first side wall, and the case is configured to accommodate a developing agent therein. The developer carrying member is supported to the first side wall and the second side wall and rotatable about a rotation axis extending in the particular direction, and the developer carrying member is configured to carry the developing agent. The developer supplying member is supported to the first side wall and the second side wall and rotatable about a rotary axis extending in the particular direction, and the developer supplying member is configured to supply the developing agent onto the developer carrying member. The cap is configured to seal the toner fill-hole. The electrode is configured to supply a bias voltage to at least one of the developer carrying member and the developer supplying member. The fixing member is configured to fix the electrode to the cap such that the electrode is disposed in superposed relation to the cap in the particular direction upon fixing with the fixing member.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings;

FIG. **1** is a schematic cross-sectional side view of a laser printer including a process cartridge provided with a developer cartridge according to a first embodiment of the present invention;

FIG. **2** is a perspective view as viewed from a left rear side of the process cartridge shown in FIG. **1**;

FIG. **3** is a perspective view as viewed from a right front side of the process cartridge shown in FIG. **1**;

FIG. **4** is a perspective view of the developer cartridge as viewed from a right front top side thereof;

FIG. **5** is a cross-sectional view of the developer cartridge shown in FIG. **4**;

FIG. **6** is a perspective view of the developer cartridge as viewed from a left rear top side thereof, and particularly showing an agitator, and a case including left and right side walls and a bottom wall;

FIG. **7** is a perspective view of the developer cartridge as viewed from the a right rear side thereof, in which a cap, a supply electrode and the developer electrode are omitted;

FIG. **8** is a cross-sectional view of a right end portion of the developer cartridge taken along a plane containing a central axis of a toner fill-hole;

FIG. **9** is an exploded perspective view of the developer cartridge as viewed from the right front side thereof, in which the cap, the supply electrode, and a screw are unfastened from the case, while a developer electrode is omitted;

FIG. **10** is an exploded perspective view of the developer cartridge as viewed from right front top side thereof, in which the supply electrode and the screw are unfastened from the case, while the developer electrode is omitted;

FIG. **11** is an exploded perspective view of the developer cartridge as viewed from right front top side thereof, in which the screw are unfastened from the case, while the developer electrode is omitted;

FIG. **12** is a right side view of the developer cartridge shown in FIG. **1**.

FIG. **13** is a perspective view of the process cartridge shown in FIG. **3** during assembly to the main casing;

FIG. **14** is a perspective view of the process cartridge shown in FIG. **3** in a state where attachment of the process cartridge to the main casing **2** is completed; and

FIG. **15** is a perspective view of the process cartridge shown in FIG. **3** in a state where the process cartridge is inserted to a main casing of a laser printer which is incompatible with the process cartridge shown in FIG. **3**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Next, a preferred embodiment of the present invention will be described in detail while referring to the accompanying drawings.

1. Laser Printer

FIG. **1** shows a laser printer **1** provided with a main casing **2**. A cartridge-mounting opening **3** is formed in a side wall constituting the front surface of the main casing **2**. A front cover **4** is provided over the cartridge-mounting opening **3** for opening and closing the same.

The side of the laser printer **1** normally faced by the user is defined as the front side in a front-rear direction. When a laser printer **1** is placed on a flat surface, the direction orthogonal to this flat surface is the vertical direction, and the left and right sides of the laser printer **1** are defined based on the perspective of the user facing the front of the laser printer **1**.

A process cartridge **5** is mounted inside the main casing **2** at a position slightly forward of center. The process cartridge **5** is mounted in the main casing **2** and removed from the main casing **2** through the cartridge-mounting opening **3** while the front cover **4** is in its open state.

The process cartridge **5** is configured of a drum cartridge **6**, and a developer cartridge **7** that is detachably mounted on the drum cartridge **6**.

The drum cartridge **6** includes a drum frame **8**. A photosensitive drum **9** is rotatably held in the rear end portion of the drum frame **8**. The drum frame **8** also retains a charger **10**, and a transfer roller **11**. The charger **10** is disposed on the rear side of the photosensitive drum **9** and the transfer roller **11** is disposed beneath the photosensitive drum **9**.

The portion of the drum frame **8** forward of the photosensitive drum **9** constitutes a cartridge-mounting unit **12**. The developer cartridge **7** is mounted in the cartridge-mounting unit **12**.

The developer cartridge **7** includes a case **13** that accommodates toner. A hopper **14** and a developing chamber **15** are formed inside the case **13**. The hopper **14** and developing chamber **15** are adjacent in the front-rear direction and in communication with each other.

The hopper **14** is a space for accommodating toner. An agitator **16** is disposed inside the hopper **14**. The agitator **16** is formed of a resinous film and is affixed to an agitator shaft **17** that extends in the left-right direction. The agitator **16** is capable of rotating together with the agitator shaft **17**. By rotating, the agitator **16** agitates toner accommodated in the hopper **14** and supplies the toner from the hopper **14** into the developing chamber **15**.

A developing roller **18** (a developer carrying member) and a supply roller **19** (a developer supplying member) are provided in the developing chamber **15**, respectively. The developing roller **18** is rotatably provided on a developing-roller shaft **20**, and the supply roller **19** is rotatably provided on a supply-roller shaft **21**. Both the developing-roller shaft **20** and supply-roller shaft **21** are oriented in the left-right direction. The developing roller **18** is positioned in the developing chamber **15** so that a portion of its peripheral surface is exposed through the rear end of the case **13**. The developer cartridge **7** is mounted in the drum cartridge **6** such that the surface of the developing roller **18** contacts the peripheral surface of the photosensitive drum **9**. The supply roller **19** is disposed so that its peripheral surface contacts the surface of the developing roller **18** from the lower front side thereof. The supply roller **19** supplies toner from the developing chamber **15** onto the surface of the developing roller **18** so that the developing roller **18** carries a thin layer on its surface.

An exposure unit **22** is also provided in the main casing **2** above the process cartridge **5**. The exposure unit **22** includes a laser light source and the like.

During an image-forming operation, the photosensitive drum **9** rotates clockwise in a left-side view at a constant velocity. As the photosensitive drum **9** rotates, the charger **10** applies a uniform charge to the surface of the photosensitive drum **9** through electrical discharge. In the meantime, the exposure unit **22** emits a laser beam based on image data received from a personal computer (not shown) connected to the laser printer **1**. The laser beam passes between the charger **10** and developer cartridge **7** and is irradiated on the surface of the positively charged photosensitive drum **9**. By selectively exposing the surface of the photosensitive drum **9**, electrical charge is selectively removed from the exposed regions of the photosensitive drum **9**, forming an electrostatic latent image on the surface of the photosensitive drum **9**. As the photosensitive drum **9** rotates and brings the latent image opposite the developing roller **18**, the developing roller **18** supplies toner onto the latent image, forming a toner image on the surface of the photosensitive drum **9**.

A sheet-feeding cassette **23** is disposed in the bottom section of the main casing **2**. The sheet-feeding cassette **23** accommodates sheets P of paper. A pickup roller **24** is disposed above the front end of the sheet-feeding cassette **23** for feeding sheets P from the sheet-feeding cassette **23** to be printed.

A conveying path **25** is formed inside the main casing **2**. The conveying path **25** is S-shaped in a side view and leads from the sheet-feeding cassette **23** to a discharge tray **26** formed on the top surface of the main casing **2** while passing between the photosensitive drum **9** and transfer roller **11**. A separating roller **27** and separating pad **28** disposed in confrontation with each other, a pair of feeding rollers **29**, a pair of registration rollers **30**, and a pair of discharge rollers **31** are provided on the conveying path **25** in sequence along the conveying direction of the sheet P.

Sheets P fed from the sheet-feeding cassette **23** pass between the separating roller **27** and separating pad **28**, where they are separated so that only one sheet is conveyed at a time. The feeding rollers **29** subsequently convey the sheets toward the registration rollers **30**. The registration rollers **30** then convey the sheets P to a position between the photosensitive drum **9** and transfer roller **11** at a precise timing.

As the photosensitive drum **9** rotates to bring the toner image on its peripheral surface opposite the sheet P passing between the photosensitive drum **9** and transfer roller **11**, the toner image is transferred onto the sheet P by the electrical attraction of the transfer roller **11**.

A fixing unit **32** is provided along the conveying path **25** downstream of the transfer roller **11** in the paper-conveying direction. A sheet P conveyed along the conveying path **25** passes through the fixing unit **32** after having the toner image transferred thereon. The fixing unit **32** applies heat and pressure to the sheet P for fixing the toner image to the same.

The laser printer **1** is provided with two operating modes: a single-sided mode for forming a toner image on one surface

of the sheet P, and a duplex mode for forming a toner image on one surface of the sheet P and subsequently forming another toner image on the other surface of the sheet P.

In the single-sided mode, the discharge rollers **31** discharge the sheet P onto the discharge tray **26** after a toner image has been formed on one side surface.

In order to implement the duplex mode, a reverse conveying path **33** is also formed in the main casing **2**. The reverse conveying path **33** extends between the conveying path **25** and sheet-feeding cassette **23** from a point near the discharge rollers **31** to a portion of the conveying path **25** between the feeding rollers **29** and registration rollers **30**. Along the reverse conveying path **33** are provided a pair of first reverse conveying rollers **34**, and a pair of second reverse conveying rollers **35**.

In the duplex mode, the discharge rollers **31** do not discharge the sheet P onto the discharge tray **26** after an image has been formed on one side surface thereof, but instead convey the sheet P onto the reverse conveying path **33**. The first reverse conveying rollers **34** and second reverse conveying rollers **35** sequentially convey the sheet P along the reverse conveying path **33** to the conveying path **25**, effectively inverting the sheet P so that the surface on which an image has not been formed confronts the peripheral surface of the photosensitive drum **9**. After an image is formed on the other side surface of the sheet P, the duplex image-forming process is complete, and the discharge rollers **31** discharge the sheet P onto the discharge tray **26**.

2. Drum Cartridge

As shown in FIGS. **2** and **3**, the drum frame **8** of the drum cartridge **6** is configured of a left wall **41** and a right wall **42**. The left and right walls **41** and **42** of the drum frame **8** are both plate-shaped and elongated in the front-rear direction. The left and right walls **41** and **42** are disposed parallel to and are spaced apart in the left-right direction. A front wall **43** bridges the front edges of the left and right walls **41** and **42**, and a rear wall **44** bridges the rear edges of the left and right walls **41** and **42**. As shown in FIG. **1**, a bottom wall **45** bridges the lower edges of the left and right walls **41** and **42**. As shown in FIGS. **2** and **3**, a top wall **46** bridges the top edges of the left and right walls **41** and **42** on the rear side thereof so as to provide a top cover over the rear section of the drum frame **8**.

The photosensitive drum **9** and transfer roller **11** are rotatably supported in the left and right walls **41** and **42** between the top wall **46** and bottom wall **45**. As shown in FIG. **1**, an opening **47** is formed in the bottom wall **45** at a position forward of the photosensitive drum **9** and transfer roller **11** for allowing the sheets P to pass through the bottom wall **45**. Further, an opening **48** is formed in the rear wall **44** at a position confronting the contact point between the photosensitive drum **9** and transfer roller **11** for allowing the sheets P to pass through the rear wall **44**. Thus, a sheet P enters the drum cartridge **6** through the opening **47** and, after passing between the photosensitive drum **9** and transfer roller **11**, exits the drum cartridge **6** through the opening **48**. As shown in FIGS. **1** and **2**, the charger **10** is provided on the top wall **46**.

As shown in FIG. **2**, an incompatibility protrusion **49** is formed on the front end of the left wall **41** and protrudes leftward therefrom. The incompatibility protrusion **49** first extends vertically upward, bends and extends downward, and bends and extends rearward.

3. Developer Cartridge

(1) Case

The case **13** of the developer cartridge **7** is formed of a resin such as polystyrene. As shown in FIG. **4**, the case **13** includes a left wall **51** (a second side wall) and a right wall **52** (a first side wall) arranged parallel to each other and spaced apart in the left-right direction. As shown in FIG. **5**, the case **13** further includes a top wall **53** bridging the top edges of the left and right walls **51** and **52**, and a bottom wall **54** bridging the bottom edges of the left and right walls **51** and **52**.

As shown in FIGS. **5** and **6**, the bottom wall **54** is integrally configured of a lip part **55** that extends farther rearward than the rear edge of the top wall **53** and confronts the developing roller **18** from below; a first curved part **56** that has a semicircular cross section and extends forward from the front edge of the lip part **55** while curving about the bottom peripheral surface of the supply roller **19**; a second curved part **57** having a semicircular cross section that extends forward from the front edge of the first curved part **56** while curving downward and back upward so that its convex side faces downward; a partitioning part **58** extending upward from the front (top) edge of the second curved part **57**; and a bent part **59** that extends forward from a vertical midpoint of the partitioning part **58** while bending in steps that are progressively higher toward the front.

A pair of ribs **60** and **61** is formed on the bottom surface of the top wall **53** at a midpoint in the front-rear direction thereof. The ribs **60** and **61** span across the entire left-right dimension of the top wall **53** and are separated by a small gap in the front-rear direction. A sealing material (not shown) is provided between the ribs **60** and **61**. The top edge of the partitioning part **58** constituting the bottom wall **54** is inserted between the ribs **60** and **61** and placed in contact with the sealing material. The front edge of the top wall **53** is bonded to a front-rear midpoint of the bent part **59** constituting the bottom wall **54**. The portion of the bent part **59** positioned to the rear of the bonded portion is separated from the top wall **53**, forming a space **62** on the front side of the partitioning part **58** that is defined by the left wall **51**, right wall **52**, top wall **53**, partitioning part **58**, and bent part **59**. The hopper **14** and developing chamber **15** are formed on the rear side of the partitioning part **58**. Thus, the hopper **14** and developing chamber **15** are completely separated from the space **62** by the partitioning part **58** and the sealing material.

The partitioning part **58** may be formed separately from the rest of the bottom wall **54**. With this construction, the space **62** can be used to accommodate toner by removing the partitioning part **58**, thereby increasing the capacity of the developer cartridge **7** for accommodating toner. Therefore, bottom walls **54** formed in the same mold can be used to manufacture both a small-capacity developer cartridge **7** having a relative small toner-accommodating capacity, and a large-capacity developer cartridge **7** having a relatively large toner-accommodating capacity.

A grip part **63** is formed on the front end of the bent part **59**. The center portion of the grip part **63** in the left-right direction bulges upward, forming a general C-shape in a front-side view with the opening of the "C" facing downward. The user or the like grips the grip part **63** by hand to carry the developer cartridge **7**. Bonding the top wall **53** to a front-rear midpoint of the bent part **59** ensures that the bent part **59** remains rigid when the user grips the grip part **63**.

The hopper **14** is a space formed above the second curved part **57**.

As shown in FIG. **6**, a round toner fill-hole **71** (a toner fill-hole) is formed in a region of the right wall **52** facing the hopper **14**. As shown in FIG. **7**, an agitator bearing ring **72** and three ring support parts **73** are formed inside the toner fill-hole **71**. The agitator bearing ring **72** is provided in the center of the toner fill-hole **71**. The ring support parts **73** are thin bar-like members that span between the inner circumferential surface of the toner fill-hole **71** and the outer circumferential surface of the agitator bearing ring **72**. The three ring support parts **73**

extend radially from the agitator bearing ring **72** at equal angles (intervals of 120 degrees).

A round agitator bearing hole **74** is formed in the left wall **51** at a position opposing the agitator bearing ring **72** in the left-right direction.

As shown in FIGS. **6** through **8**, the right and left ends of the agitator shaft **17** are rotatably inserted into the agitator bearing ring **72** and agitator bearing hole **74**, respectively. With this configuration, the agitator shaft **17** (and, hence, the agitator **16**) is capable of rotating about an axis aligned with the center of the toner fill-hole **71**.

Accordingly, the orientation of the agitator **16** is visible from the outside of the case **13** through the toner fill-hole **71**. This construction makes it easy to confirm that the agitator shaft **17** is retained in the agitator bearing ring **72** and agitator bearing hole **74**.

The toner fill-hole **71** is used for filling the hopper **14** with toner. By configuring the ring support parts **73** of thin bar-like members, sufficiently large openings can be maintained between the ring support parts **73** for allowing the hopper **14** to be smoothly filled with toner.

As shown in FIG. **7**, the cross section of the ring support part **73** taken orthogonal to the longitudinal direction is shaped like the home plate on a baseball field, tapering toward the right. Hence, when the hopper **14** is being filled with toner, the toner is readily introduced into the hopper **14** along the tapered cross-sectional shape of the ring support part **73**. Hence, the hopper **14** can be smoothly filled with toner.

The right end of the agitator shaft **17** has a cross-like shape when viewed from the right side. When the right end of the agitator shaft **17** is inserted into the agitator bearing ring **72**, gaps are formed between the right end of the agitator shaft **17** and the inner peripheral surface of the agitator bearing ring **72**. Therefore, toner can enter the hopper **14** through these gaps when the hopper **14** is being filled with toner, enabling the hopper **14** to be filled more smoothly.

The agitator bearing hole **74** of the left wall **51** also functions as an air release opening when residual toner is being extracted from the hopper **14** through the toner fill-hole **71**. Thus, residual toner can be smoothly extracted from the hopper **14**.

As shown in FIGS. **7** and **8**, a fitting wall part **75** is formed on the right wall **52**. The fitting wall part **75** protrudes rightward from the periphery of the toner fill-hole **71**. The inner peripheral surface of the fitting wall part **75** is a cylindrical surface formed continuously with the inner peripheral surface of the toner fill-hole **71**. As shown in FIG. **7**, an engagement part **76** (a predetermined portion) is integrally formed on an outer circumferential part of the fitting wall part **75**. The engagement part **76** protrudes diagonally upward and forward from the fitting wall part **75**. An engagement recess **77** is formed in the engagement part **76**. The engagement recess **77** is circular in a side view and is recessed leftward (inward) from the right surface of the engagement part **76**. A flange **78** is integrally formed along the outer peripheral edges of the fitting wall part **75** and engagement part **76**, expanding radially outward from the fitting wall part **75** and engagement part **76**. As shown in FIG. **8**, the flange **78** (an attachment portion) has a stepped surface **79** formed by bending the outer peripheral edge of the flange **78** rightward. The stepped surface **79** is recessed relative to the rightmost surface of the flange **78**.

As shown in FIG. **6**, developing-roller bearing holes **81** and **82** are formed in the left and right walls **51** and **52**, respectively, at positions above the lip part **55**. The developing-roller bearing holes **81** and **82** penetrate the left and right walls **51** and **52** in the left-right direction and open outward in the rear edges of the left and right walls **51** and **52**. The left and right ends of the developing-roller shaft **20** are inserted through the open rear edges of the developing-roller bearing holes **81** and **82** so that the developing-roller shaft **20** is rotatably supported in the developing-roller bearing holes **81** and **82**. Both ends of the developing-roller shaft **20** protrude outward from the left and right walls **51** and **52**.

Similarly, supply-roller bearing holes **83** and **84** are formed in the left and right walls **51** and **52**, respectively, at positions above the first curved part **56**. The supply-roller bearing holes **83** and **84** penetrate the left and right walls **51** and **52** to form a groove that is U-shaped in a side view with the opening of the "U" on the rear. The left and right ends of the supply-roller shaft **21** are respectively inserted into the supply-roller bearing holes **83** and **84** from the rear side thereof so that the supply-roller shaft **21** is rotatably supported in the supply-roller bearing holes **83** and **84**. The ends of the supply-roller shaft **21** protrude outward from the left and right walls **51** and **52**.

(2) Cap

As shown in FIG. **8**, a cap **91** is fitted into the fitting wall part **75** of the case **13**. The cap **91** is formed of the same resin as the case **13** and functions to seal the toner fill-hole **71**. As shown in FIGS. **8** and **9**, the cap **91** is integrally formed of a main body part **92**, a circumferential part **93**, a boss **94**, and six ribs **95**. The cap **91** also functions to fix a supply electrode **101** described later.

The main body part **92** of the cap **91** is the portion that is fitted inside the fitting wall part **75**. The main body part **92** has an angular C-shape in a cross-sectional view and is integrally configured of a cylindrical part that contacts the inner peripheral surface of the fitting wall part **75**, and a part for closing the left end of the cylindrical part.

The circumferential part **93** protrudes radially outward from the right edge of the main body part **92** to form a flange that contacts the stepped surface **79** of the fitting wall part **75**. The circumferential part **93** is welded to the stepped surface **79**. Thus, the border between the stepped surface **79** and circumferential part **93** is not exposed on the outer side. This construction prevents a tool or the like from being inserted into the border between the stepped surface **79** and circumferential part **93**, thereby preventing the cap **91** from inadvertently being pulled out of the toner fill-hole **71**. By welding the circumferential part **93** of the cap **91** to the stepped surface **79**, the cap **91** is firmly fixed to the fitting wall part **75**, enabling the supply electrode **101** (described later), which is fixed to the cap **91**, to be maintained in a fixed position with greater stability.

As shown in FIG. **9**, an engaging part **96** for engaging with the engagement part **76** is formed on the circumferential part **93**. A columnar protrusion **97** is formed on the left endface of the engaging part **96** to be fitted into the engagement recess **77**. Fitting the columnar protrusion **97** into the engagement recess **77** fixes the position of the cap **91** relative to the fitting wall part **75** in the circumferential direction of the toner fill-hole **71**.

The boss **94** (an electrode mounting portion) has a general cylindrical shape and extends rightward from the main body part **92** along the central axis of the main body part **92** (toner fill-hole **71**). As shown in FIG. **10**, the right end of the boss **94** has a general elliptical shape formed by cutting off circumferential parts of the cylindrical shape that have rotational symmetry. As a result, the right end of the boss **94** has wide parts **98** positioned on either side of the hollow region in the longitudinal direction of the substantially elliptical shape, and narrow parts **99** positioned on either side of the hollow region in the latitudinal direction of the elliptical shape.

The six ribs **95** are formed to extend radially from the outer circumferential surface of the boss **94** toward the main body part **92**.

(3) Electrodes

As shown in FIGS. **9** through **11**, a supply electrode **101** is provided on the developer cartridge **7** for supplying a bias voltage to the supply roller **19**. The supply electrode **101** is formed of a conductive resin material and is integrally configured of a crowning part **102** that crowns the right end of the supply-roller shaft **21**; a first extension part **103** extending from the crowning part **102** toward the boss **94** of the cap **91**; a fixing part **104** formed on the distal end of the first extension part **103** for fixing the supply electrode **101** to the boss **94**; a second extension part **105** extending upward from the fixing part **104**; a contact point **106** formed on the upper edge of the second extension part **105** for contacting a body-side supply electrode (not shown) provided inside the main casing **2**; and a contact part **107** (see FIG. **9**) protruding outward from the left (rear) surface of the second extension part **105** for contacting the circumferential part **93** of the cap **91**.

A fitting hole **108** is formed in the fixing part **104**, penetrating the fixing part **104** in the left-right direction. The fitting hole **108** has a general elliptical shape that corresponds to the outer shape of the right end portion of the boss **94** (the portion of the boss **94** whose outer shape is generally elliptical).

With the crowning part **102** mounted over the right end portion of the supply-roller shaft **21**, the right end of the boss **94** fitted into the fitting hole **108** formed in the fixing part **104**, and the contact part **107** contacting the circumferential part **93** of the cap **91**, the supply electrode **101** is fixed to the cap **91** by threading a screw **109** (a fixing member) into the center hollow portion of the boss **94**. This construction prevents the screw **109** from damaging the supply electrode **101**, even when the supply electrode **101** is formed of a relatively fragile conductive resin, since the shaft of the screw **109** is screwed into the hollow center portion (threaded hole) of the boss **94** provided on the cap **91**.

The fixing part **104** is in contact with a stepped surface positioned a step lower than the right endface of the boss **94**. The right surface of the fixing part **104** is flush with the right endface of the boss **94**. The head of the screw **109** straddles and contacts both the right endface of the boss **94** and the right surface of the fixing part **104**.

The supply electrode **101** is disposed in a position for overlapping the cap **91** in the left-right direction. The overlapping portion of the supply electrode **101** is fixed to the cap **91**. With this construction, the supply electrode **101** is fixed via at least two parts, including the part of the supply electrode **101** connected to the supply-roller shaft **21** and the part of the supply electrode **101** overlapping the cap **91**. Accordingly, the position of the supply electrode **101** can be maintained with stability.

Using the screw **109** to fix the supply electrode **101** to the cap **91** allows for fine adjustments in the position of the supply electrode **101**. Thus, the supply electrode **101** can be placed in its optimum position through these fine adjustments. Further, if the supply electrode **101** becomes damaged, the damaged supply electrode **101** can easily be replace with a new supply electrode **101**.

Positioning the supply electrode **101** to overlap the cap **91** can prevent the cap **91** from being removed inadvertently from the toner fill-hole **71**.

Further, the fixing part **104** formed on the supply electrode **101** is fixed in contact with the boss **94** using the screw **109**, while the contact part **107** formed on the supply electrode **101** contacts a portion of the cap **91** other than the boss **94**. Accordingly, the supply electrode **101** is supported on the cap **91** at two points: the fixing part **104** and contact part **107**. Thus, the position of the supply electrode **101** can be maintained with greater stability.

Providing the boss **94** with the wide parts **98** enhances the strength of the boss **94**, while the narrow parts **99** of the boss **94** enable a screw **109** with a small head to apply pressure through its head to the portions of the fixing part **104** around the fitting hole **108**, without the use of a washer. Accordingly, the screw **109** used for fixing the supply electrode **101** may be the same screw used in other parts of the developer cartridge **7**.

By engaging the engaging part **96** with the engagement part **76**, the cap **91** can be attached to the right wall **52** with the boss **94** in a fixed orientation. Since the boss **94**, which has a generally elliptical outer shape, is set to a fixed orientation, the supply electrode **101** possessing the fitting hole **108**, which also has a generally elliptical shape, can be set to a fixed orientation. Thus, the position of the supply electrode **101** can be maintained reliably in its fixed position.

As shown in FIG. **12**, a developing electrode **111** is provided on the developer cartridge **7**. The developing electrode **111** is formed of the same conductive resin as the supply electrode **101** and is integrally configured of a crowning part **112** that crowns the right end of the developing-roller shaft **20**; an extension part **113** that extends forward from the crowning part **112**, then bends and extends upward; and a contact point **114** formed on the top edge of the extension part **113** for contacting a body-side developing electrode (not shown) provided inside the main casing **2**. The developing electrode **111** is fixed to the case **13** by a screw **115** inserted into the bent portion of the extension part **113**. The screw **115** is screwed into a boss **116** (see FIG. **11**) protruding from the case **13**.

(4) Gear Cover

As shown in FIG. **4**, a gear cover **121** is attached to the left side surface of the case **13**. The gear cover **121** covers nearly the entire left side surface of the case **13**. Gears inside the cartridge-mounting unit **12** are attached to the developing-roller shaft **20**, supply-roller shaft **21**, and the like. An incompatibility protrusion **122** is provided on the front edge of the gear cover **121** and extends leftward.

4. Mounting the Process Cartridge in the Main Casing

As shown in FIGS. **13** and **14**, spaces **131** and **132** are provided inside the main casing **2** for allowing passage of the incompatibility protrusion **49** of the drum cartridge **6** and the incompatibility protrusion **122** of the developer cartridge **7** when the process cartridge **5** is mounted in the main casing **2**. In other words, no members are provided in regions through which the incompatibility protrusions **49** and **122** pass as the process cartridge **5** is mounted in or removed from the main casing **2**.

Hence, with the front cover **4** in its open state, the process cartridge **5** is inserted into the main casing **2** via the cartridge-mounting opening **3**, as shown in FIG. **13**. Subsequently, the process cartridge **5** can be moved smoothly into the cartridge-mounted position shown in FIG. **14**.

However, if the process cartridge **5** is inserted into a main casing **201** of a printer different from the laser printer **1**, as shown in the example of FIG. **15**, the incompatibility protrusion **49** contacts a barrier **202** within the main casing **2** and/or the incompatibility protrusion **122** contacts a barrier **203** within the main casing **2** as the process cartridge **5** is inserted rearward, preventing the process cartridge **5** from moving farther rearward into a mounted position. This structure prevents the process cartridge **5** from being mounted in the main casing **201** of an incompatible printer. Further, since the

incompatibility protrusions **49** and **122** are provided on the front ends of the drum cartridge **6** and developer cartridge **7**, respectively, the state of contact between the incompatibility protrusions **49** and **122** and the corresponding barriers **202** and **203** can be confirmed visually.

The developer cartridge of the present invention has practical use in the image-forming industry as the cartridge can securely maintain the positions of its electrodes and can ensure good connections between its electrodes and electrodes provided in the body of an image-forming device.

While the invention has been described in detail and with reference to the embodiments thereof, it would be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the scope and spirit of the invention.

What is claimed is:

1. A developer cartridge comprising:

a case having a first side wall formed with a toner fill-hole and a second side wall facing the first side wall in a particular direction, the case being configured to accommodate a developing agent therein;

a developer roller supported to the first side wall and the second side wall and rotatable about a rotation axis extending in an axial direction parallel to the particular direction, the developer roller being configured to carry the developing agent;

a supply roller supported to the first side wall and the second side wall and rotatable about a rotation axis extending in the axial direction, the supply roller being configured to supply the developing agent onto the developer roller;

a cap configured to seal the toner fill-hole, the cap having:

a main body part closing the toner fill-hole; and

a boss extending outward from the main body part in the axial direction, the boss including an end in the axial direction;

an electrode made from electrically conductive resin and configured to supply a bias voltage to at least one of the developer roller and the supply roller, the electrode being overlapped with the cap as viewed in the axial direction, the electrode having:

a first end part contacting with the at least one of the developing roller and the supply roller;

a second end part including a contact point; and

an extending part extending from the first end part to the second end part, the extending part including a fitting hole into which the boss is fitted; and

a screw configured to fix the electrode to the cap by being threaded into the end of the boss in a state where the boss is fitted into the fitting hole, wherein the screw has a shaft portion threadingly engaged with the cap.

2. The developer cartridge according to claim **1**,

wherein the cap has an electrode mounting portion, and

wherein the electrode has a fixed part fixed to and in contact with the electrode mounting portion by the screw, and has a contact part configured to be in contact with the cap at a portion other than the electrode mounting portion.

3. The developer cartridge according to claim **1**,

wherein the boss has an elliptical cross-sectional shape taken along a plane perpendicular to a direction of insertion of the screw into the boss.

4. The developer cartridge according to claim **1**,

wherein the cap has an engaging part, and

wherein the first side wall has a predetermined portion, the engaging part being configured to be engaged with the predetermined portion in a state where the boss is in a predetermined orientation.

5. The developer cartridge according to claim **1**,

wherein the first side wall has an attachment portion at a position around the toner fill-hole to allow the cap to be attached to the attachment portion, the attachment portion having an endmost surface and a stepped surface recessed inwardly from the endmost surface in the axial direction, and

wherein the cap has a circumferential part in abutment with the stepped surface.

6. A developer cartridge comprising:

a case having a first side wall formed with a toner fill-hole and a second side wall facing the first side wall in a particular direction, the case being configured to accommodate a developing agent therein;

a developer roller supported to the first side wall and the second side wall and rotatable about a rotation axis extending in an axial direction parallel to the particular direction, the developer roller being configured to carry the developing agent;

a supply roller supported to the first side wall and the second side wall and rotatable about a rotation axis extending in the axial direction, the supply roller being configured to supply the developing agent onto the developer roller;

a cap configured to seal the toner fill-hole, the cap having:

a main body part closing the toner fill-hole; and

a boss extending outward from the main body part in the axial direction, the boss including an end in the axial direction;

an electrode configured to supply a bias voltage to at least one of the developer roller and the supply roller, the electrode being overlapped with the cap as viewed in the axial direction, the electrode having:

a first end part contacting with the at least one of the developing roller and the supply roller;

a second end part including a contact point; and

an extending part extending from the first end part to the second end part, the extending part including a fitting hole into which the boss is fitted; and

a screw configured to fix the electrode to the cap by being threaded into the end of the boss in a state where the boss is fitted into the fitting hole,

wherein the first side wall of the case has an attachment portion at a position around the toner fill-hole to allow the cap to be attached to the attachment portion, the attachment portion having an endmost surface and a stepped surface recessed inwardly from the endmost surface in the axial direction, and

wherein the cap has a circumferential part in abutment with the stepped surface.

7. The developer cartridge according to claim **6**,

wherein the cap has an electrode mounting portion, and

wherein the electrode has a fixed part fixed to and in contact with the electrode mounting portion by the screw, and has a contact part configured to be in contact with the cap at a portion other than the electrode mounting portion.

8. The developer cartridge according to claim **6**,

wherein the boss has an elliptical cross-sectional shape taken along a plane perpendicular to a direction of insertion of the screw into the boss.

9. The developer cartridge according to claim **6**,

wherein the cap has an engaging part, and

wherein the first side wall has a predetermined portion, the engaging part being configured to be engaged with the predetermined portion in a state where the boss is in a predetermined orientation.

* * * * *